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Allegheny Observatory Search for Planetary Systems

Allegheny Observatory of the University of Pittsburgh

George D. Gatewood

Strategy

The newly developed Multichannel Astrometric Photometer (MAP) and a completely rebuilt (including new optical system) red-light 0.76-meter Thaw refractor of the University of Pittsburgh's Allegheny Observatory are employed in an astrometric observational program to detect Jupiter-like planets in orbit about nearby stars. Now in its fifth year, the program includes 15 stars and is obtaining approximately 12 good observations per year of each of them, sufficient to assure an annual normal point precision of 0.001 arcsec (1 mas) per object (Gatewood, G., et al., 1990, Ap. J. **364**, 114). While the observational program is small, it will yield the first astrometric information about planetary systems in general. The detection of jovian objects (similar in mass and orbital period to Jupiter) will yield information about specific planetary systems. If several are detected these will be suggestive of patterns involving both the characteristics of the planets and the stars which they orbit. Since, however, the technique being applied will also yield a statistically well-defined negative result, a failure to detect such systems will place the first constraints on the probable nature of planetary systems.

The astrometric technique is most sensitive to nearby planetary systems and to massive planets that have orbits that place them within the regions around a star where the temperature is sufficiently low to permit the existence of water ice grains. Thus it covers a different search space than that of radial velocity techniques. Currently the only astrometric survey program, it is complimentary to other detection programs and some target stars have been included to assure overlap with them. The minimum detectable mass varies with the particular target star from objects almost twice as massive as Neptune to bodies almost twice as massive as Jupiter.

Projected Accomplishments

1991 will be the sixth year of observation for several program stars. An initial analysis shows that all but one are moving linearly. The exception, Barnard's star, shows a small perturbation which could be a statistic variation or could indicate the presence of a small planet in an orbit with a period of 5 or more years. Preliminary analysis of this and several other stars will be published in 1992.

Publications

The following papers are from the overall Allegheny Observatory astrometric-photometric programs. They indicate its success and detail some photometric data for stars in the planetary system search program.

Gatewood, G. 1990, Castelaz, M., Persinger, T., Stein, J., Stephenson, B., and Tangren, W. 1990, Ap.J. **364**, 114.

Persinger, T., and Castelaz, M.W. 1990, A.J. **100**, 1655.